Multi-Carrier Outdoor Booster
BMB0900-150-SG07
User Manual

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The “**Multi-carrier Outdoor Booster**” must be installed only in a restricted access area.

The “**Multi-carrier Outdoor Booster**” is designed to operate according to the specification of this User Manual.

Improper installation and operation of this equipment beyond the installation procedures, beyond the designed operating specifications, and not in compliance with regulatory requirements will revoke any warranty and may:

- Prevent the equipment from performing properly
- Violate regulatory RF emissions requirements
- Require removal of the equipment from service.

Table of Contents

1 SYSTEM INTRODUCTION 1
1.1 OVERVIEW 1
1.2 SYSTEM BLOCK DIAGRAM 1
1.3 FUNCTION 2
1.4 APPLICATIONS 3
1.5 SYSTEM CONFIGURATION 3
1.5.1 Outline drawing 4
1.5.2 Interface 4
2 SYSTEM INSTALLATION 6
2.1 INSTALLATION OVERVIEW 6
2.1.1 Requirements on Installation Site 6
2.1.2 Requirements on Anti-corrosion and Shock-protection 6
2.1.3 Requirements on Illumination, Ventilation and Fire Protection 7
2.1.4 Power requirements 7
2.1.5 Requirements on Lightning Protecting and Grounding 7
2.1.6 Installation Preparation 7
2.2 CABINET INSTALLATION 7
2.2.1 Installation Requirements 7
2.2.2 Installation 8
2.2.2.1 Installation onThe Wall 8
2.2.2.2 Installation on The Floor 9
2.2.2.3 Installation on The Tower 11
2.3 CABLE INSTALLATION 12
2.3.1 Installation of Power Cable and Grounding Cable 12
2.3.1.1 Installation Requirements 12
2.3.1.2 Installation 13
2.3.2 Installation and Connection of Feeders 14
2.3.2.1 Installation Requirements 14
2.3.2.2 Installation 14
2.4 INSTALLATION INSPECTION 15
2.4.1 Booster Inspection 15
2.4.2 Cable Inspection 15
2.5 SYSTEM TEST 15
3 MAINTENANCES AND MANAGEMENTS 17
3.1 SYSTEM MAINTENANCE 17
3.1.1 Routine Maintenance 17
3.1.2 Indicator Lights 17
3.1.2.1 Monitoring and Alarm Indicator 17
3.1.2.2 Power Amplifier Indicator 18
3.2 SYSTEM MANAGEMENT 19
3.2.1 Alarm Range Setting 19

3.2.2 Power Amplifier and Low Noise Amplifier Gain Setting and Calculation 20
3.2.2.1 Gain Setting 20
3.2.2.2 Gain Calculation 21
3.2.2.3 Adjustment of PA Gain for BTS Upgrade 22
3.2.3 Alarm and Remote Shutdown Port Specification 24
4 TECHNICAL SPECIFICATIONS 26
5 APPENDIX 28

List of Figures

FIGURE 1 OUTDOOR BOOSTER 1
FIGURE 2 CONFIGURATION OF OUTDOOR BOOSTER 2
FIGURE 3 SYSTEM CONFIGURATION 3
FIGURE 4 OUTLINE DRAWING 4
FIGURE 5 OUTDOOR BOOSTER FRONT PANEL 4
FIGURE 6 OUTDOOR BOOSTER REAR INTERFACES 5
FIGURE 7 DISTANCE OF WALL INSTALLING HOLES 8
FIGURE 8 INSTALLING INFLATABLE BOLT 8
FIGURE 9 WALL MOUNTED BRACKET 9
FIGURE 10 WALL MOUNTED PREVIEW 9
FIGURE 11 DISTANCE OF FLOOR INSTALLING HOLES 10
FIGURE 12 BASE BRACKET 10
FIGURE 13 FLOOR INSTALLATION 10
FIGURE 14 TOWER MOUNTED BRACKET 11
FIGURE 15 OUTDOOR BOOSTER CABINET FIXED HOLES ON THE TOWER MOUNTED BRACKET 11
FIGURE 16 TOWER MOUNTED PREVIEW 12
FIGURE 17 INSTALLING POWER CABLE AND GROUND CABLE 13
FIGURE 18 POWER CABLE 13
FIGURE 19 CABLE INSTALLATION 14
FIGURE 20 FLOW CHART OF SYSTEM DEBUGGING 16
FIGURE 21 MONITORING AND ALARM INDICATOR LIGHTS 18
FIGURE 22 POWER AMPLIFIER INDICATORS 18
FIGURE 23 POWER AMPLIFIER AND LOW NOISE AMPLIFIER GAIN SETTING 20
FIGURE 24 ALARM AND SHUTDOWN PORT 24

List of Tables

TABLE 1 OUTDOOR BOOSTER COMPONENTS 2
TABLE 2 FRONT PANEL INTERFACES DESCRIPTION 5
TABLE 3 OUTDOOR BOOSTER REAR INTERFACES DESCRIPTION 5
TABLE 4 SPECIFICATION OF INDICATOR LIGHT 18
TABLE 5 DESCRIPTION OF POWER AMPLIFIER INDICATOR LIGHTS 19
TABLE 6 ALARM RANGE SETTING 19
TABLE 7 VALUE SETTING OF THE 4 BIT BINARY CODE SWITCH 20
TABLE 8 SYMBOL DESCRIPTION 22
TABLE 9 SPECIFICATION OF ALARM AND REMOTE SHUTDOWN PORT 25

1 System Introduction

1.1 Overview

Bravo Tech Inc's Multi-Carrier High Power Outdoor Booster provides higher downlink EIRP to extend the coverage of existing sites. The booster is weather resistant, has an advanced thermal management system and is capable of operating under IP55 environmental extremes. It works at the frequency of 890-915MHz (uplink) and 935-960MHz (downlink) with the Max input power of 43dBm.

Figure 1 Outdoor Booster

1.2 System Block Diagram

The following figure shows the system block diagram of the multi-carrier outdoor booster.

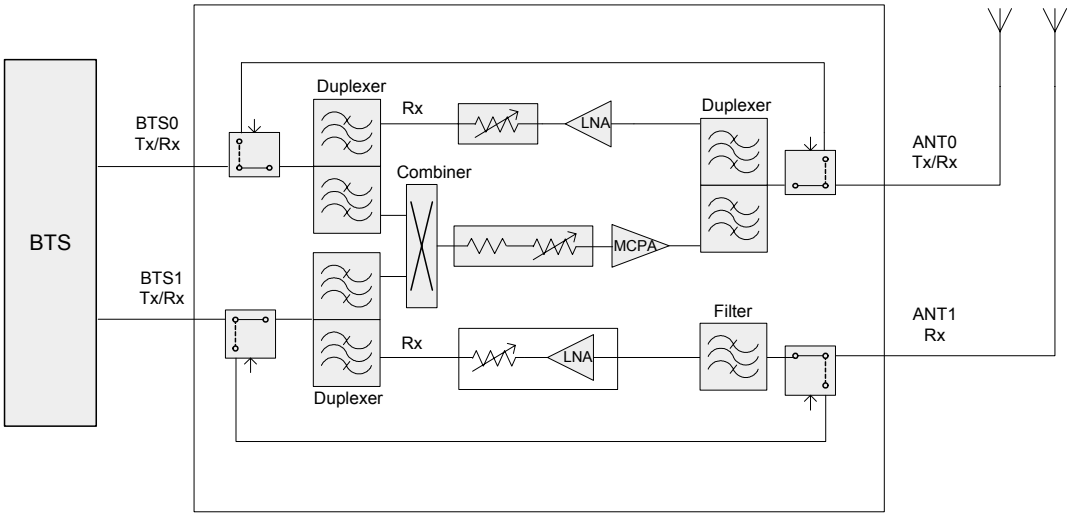


Figure 2 Configuration of Outdoor Booster

The system is composed of a downlink MCPA, duplexers, LNA, attenuator, bypass switch, control assembly, modem and power supply.

Item	Components	Qty
1	Downlink multi-carrier power amplifier	1 PCS
2	Duplexer	2 PCS
3	LNA (built-in the filters)	2 PCS
4	Attenuator	1 PCS
5	Bypass Switch	2 PCS
6	Control assembly	1 PCS
7	Modem	1 PCS
8	Power supply	1 PCS

Table 1 Outdoor Booster Components

1.3 Function

This product has the following functions:

- Amplifies downlink signal power up to 150W, so as to extend the coverage of BTS.
- Amplifies uplink signal, reduces BTS noise figure and improves uplink sensitivity.
- Auto by-pass function.
- Built-in input attenuator eliminates the need of changing BTS 'S output power.
- Extensive system monitor and control.

1.4 Applications

- Coastlines and large lakes.
- Areas far from city center, such as remote countryside.
- Long and narrow districts, such as highway, railroad, sea-route.
- Rural areas, such as grassland and desert.
- Areas where macro-BTS is difficult to be built and coverage of micro-BTS is not enough, such as mountainous region, foothill, highland.
- Areas where the coverage of micro-BTS or micro-cell is not good, such as blind spots of micro-cell coverage.
- Building coverage gaps between networks.
- Large area of low population density.
- Improving coverage into zoning restricted housing areas.

1.5 System Configuration

The system configuration of a multi-carrier outdoor booster is shown in Figure 3.

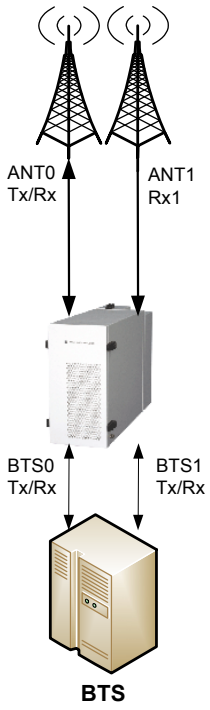


Figure 3 System Configuration

1.5.1 Outline drawing

Figure 4 shows the outline drawing of outdoor booster. Dimensions of outdoor booster are 437mm(17.2”) x 216mm(8.5”) x 706mm(27.8”) (H x W x D)

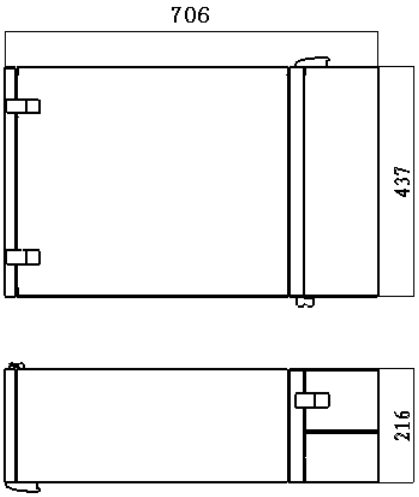


Figure 4 Outline Drawing

1.5.2 Interface

The interface of the outdoor booster is shown in Figure 5.

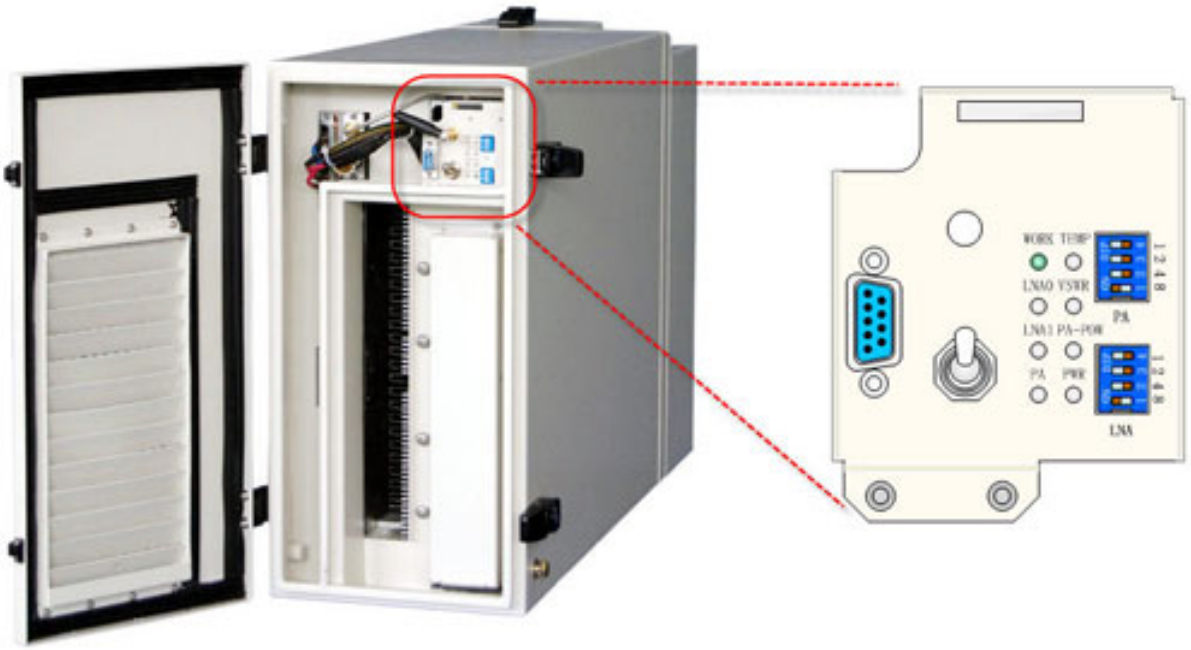


Figure 5 Outdoor Booster Front Panel

Interface	Description
Serial Port	Communication port, RS232
Power On/Off	Power On/Off switch
SIM slot	SIM card slot of wireless modem
PA Gain Binary Code Switch	1-2-4-8 binary code switch for PA gain adjustment
LNA Gain Binary Code Switch	1-2-4-8 binary code switch for LNA gain adjustment
Modem Antenna SMA Terminal	Wireless modem antenna SMA terminal
LED Indicators	8 LEDs for alarm and monitoring

Table 2 Front Panel Interfaces Description

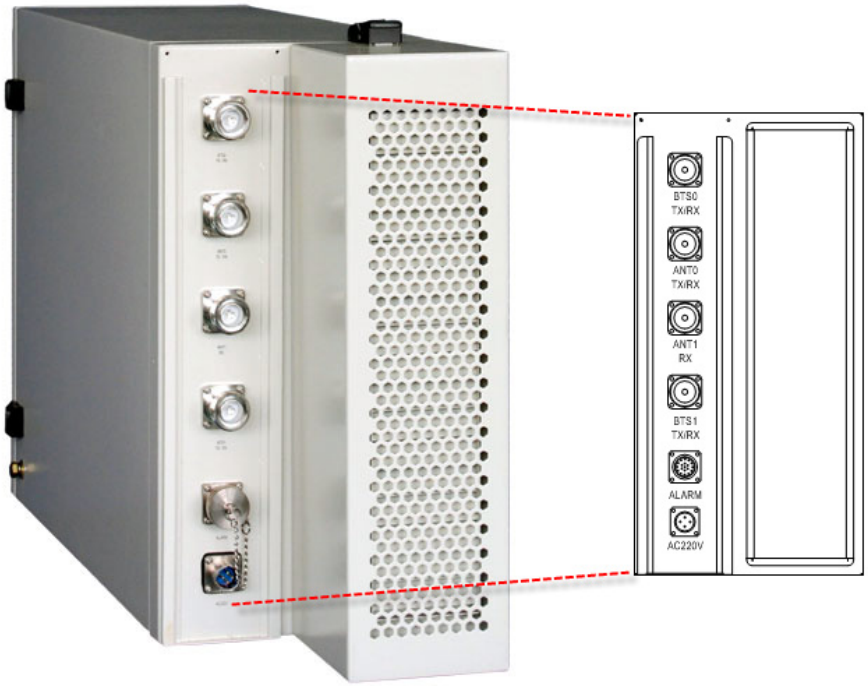


Figure 6 Outdoor Booster Rear Interfaces

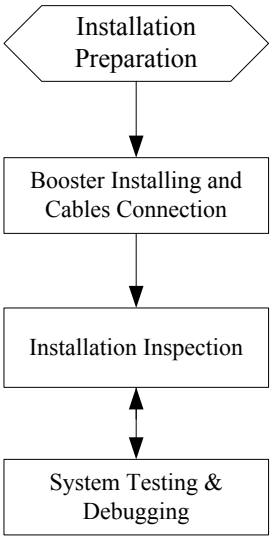
Interface	Description
AC220V	Input power interface for 220V AC
BTS0 TX/RX	Connect to BTS main TX/RX port
BTS1 TX/RX	Connect to BTS diversity TX/RX port
ANT0 TX/RX	Connect to main antenna (TX/RX)
ANT1 RX	Connect to diversity antenna (RX)
ALARM	ALARM output port(Form C alarms)

Table 3 Outdoor Booster Rear Interfaces Description

2 System Installation

This chapter introduces the installation of multi-carrier outdoor booster

Installation steps are as the following chart::



2.1 Installation Overview

2.1.1 Requirements on Installation Site

The outdoor booster could be installed on the wall or floor, and it should be installed close to the antenna. The requirements of installation site are following:

- The installation site should be non-corrosive.
- If the cabinet should be mounted on the wall, the wall's bearing capacity must be more than 55kg(122lb). Concrete and brick wall are recommended.

2.1.2 Requirements on Anti-corrosion and Shock-protection

To safeguard products and operators, the installing location must be kept away from caustic or poisonous pollutants. If the site can't meet seismic, it must be properly reinforced

2.1.3 Requirements on Illumination, Ventilation and Fire Protection

The installation site should have enough illumination for installation and maintenance needs. Flammable and explosive material should not be near to the site.

2.1.4 Power requirements

Nominal voltage: 220V AC. Variety range: 100-260 V AC, 47-63 Hz Single Phase.

The power consumption of outdoor booster is about 1,300W. Be certain to select a fuse or a breaker with the proper capacity. 10A/220V or 20A/110V breaker is recommended.

2.1.5 Requirements on Lightning Protecting and Grounding

The cross section of grounding cable should be no smaller than #4AWG(25mm^2). The grounding cable should be connected to each ground directly without any splices. Keep the grounding cable as short as possible.

2.1.6 Installation Preparation

The following tools will be used for a successful installation:

- A multimeter
- Philips screwdrivers
- Flat blade screwdrivers
- Wrenches
- A Drill
- A VSWR testing devices
- N adapters
- RF testing cables
- Power meter (part of hand-held tester)

2.2 Cabinet Installation

2.2.1 Installation Requirements

- Unused circuit breaker
- Convenient maintenance access

- Sufficient space for installation

2.2.2 Installation

> ⚠ Caution
>
> The following high-altitude operation should be only performed by qualified personnel under well protection.

2.2.2.1 Installation onThe Wall

Step	Operations
1	Hold mount in place.
2	Make 6 holes (Φ10) and drill as shown in Figure 7.
3	Install expansion bolts (concrete anchors) as shown in Figure 8. Bolt the mount into place.
4	Assemble the bracket and mount the cabinet on the bracket by using the M8*16 bolt. Mount the bracket on the Wall. (Notes: Mounting the bracket before mounting the cabinet on the bracket is acceptable.)

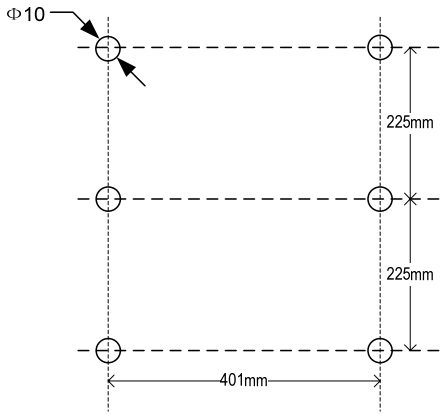


Figure 7 Distance of Wall Installing Holes

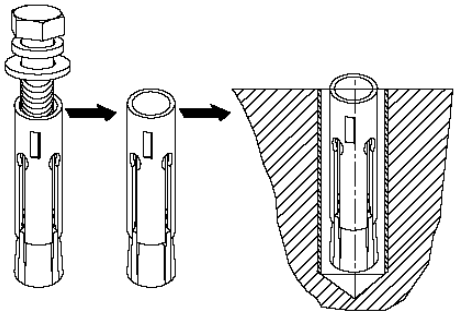


Figure 8 Installing Inflatable Bolt

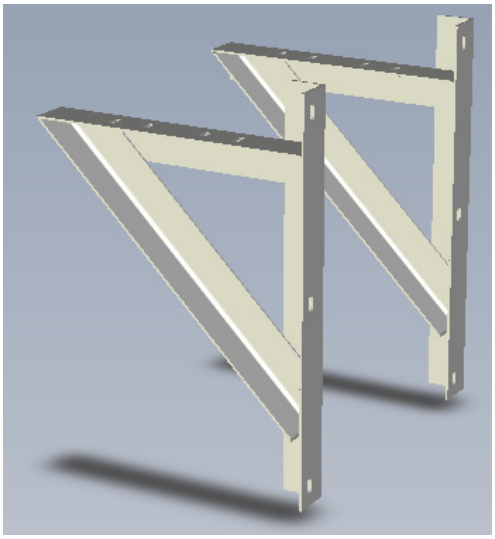


Figure 9 Wall Mounted Bracket

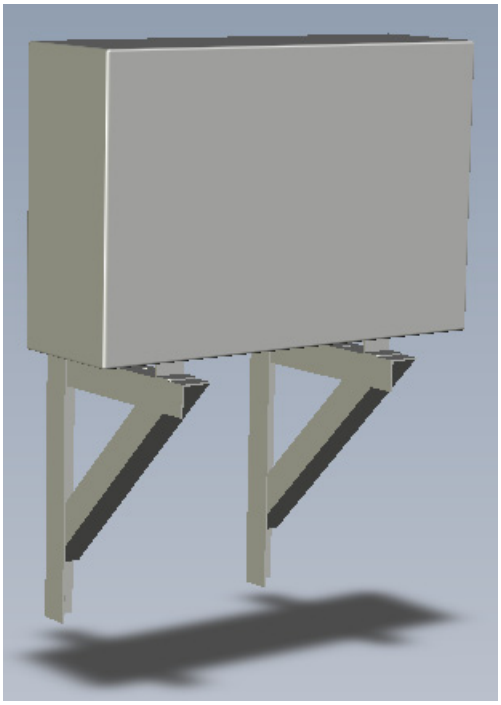


Figure 10 Wall Mounted Preview

2.2.2.2 Installation on The Floor

Step	Operations
1	Hold mount in place.
2	Make 4 holes (Φ10) and drill as shown in Figure 11.
3	Install expansion bolts (concrete anchors) as shown in Figure 8. Bolt the mount into place.
4	Assemble the bracket and mount the cabinet on the bracket by using the M8*16 bolt. Mount the bracket on the floor. (Notes: Mounting the bracket before mounting the cabinet on the bracket is acceptable.)

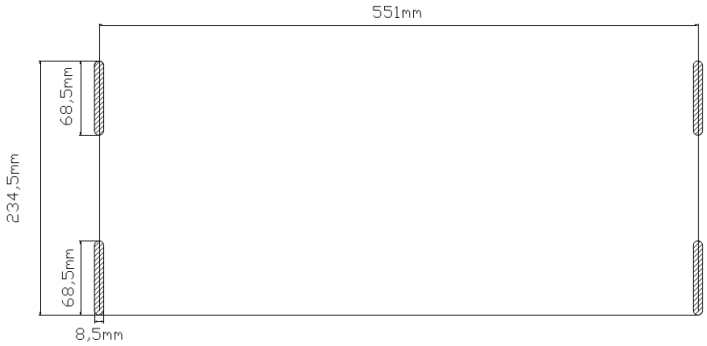


Figure 11 Distance of Floor Installing Holes

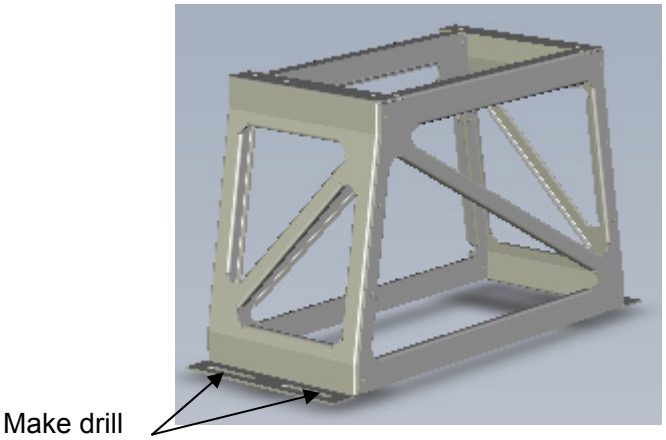


Figure 12 Base Bracket

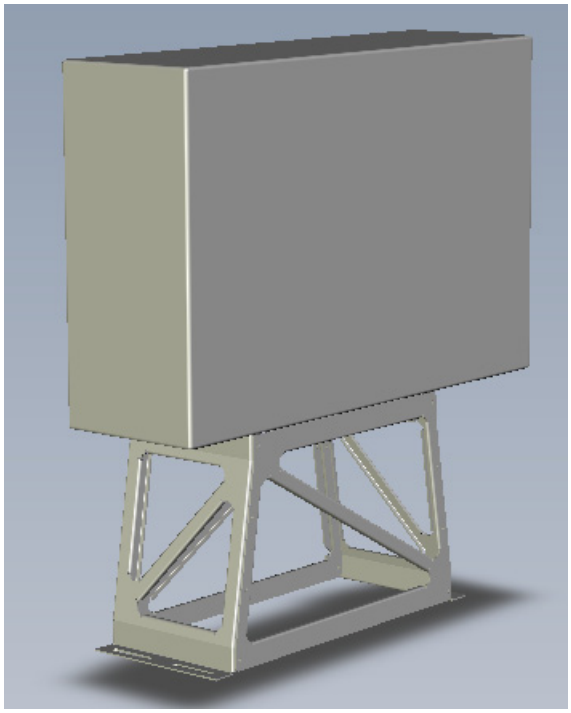


Figure 13 Floor Installation

2.2.2.3 Installation on The Tower

Step	Operations
1	Hold mount in place.
2	Assemble the bracket and mount the cabinet on the bracket by using the M8*16 bolt. Mount the bracket on the Wall with U pipe lock. (Notes: Mounting the bracket before mounting the cabinet on the bracket is acceptable.)

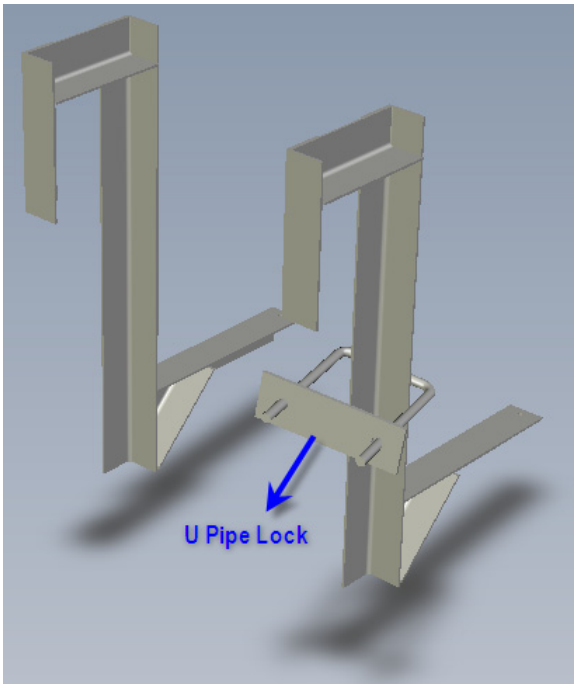


Figure 14 Tower Mounted Bracket

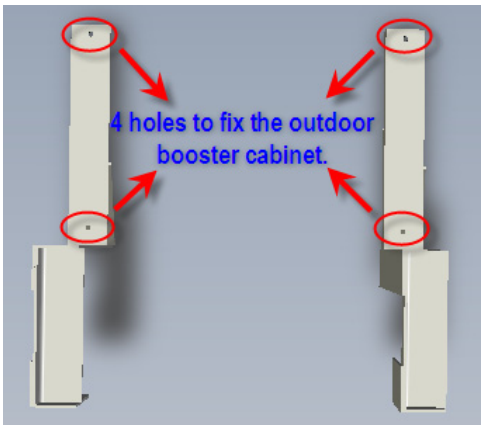


Figure 15 Outdoor Booster Cabinet fixed holes on The Tower Mounted Bracket

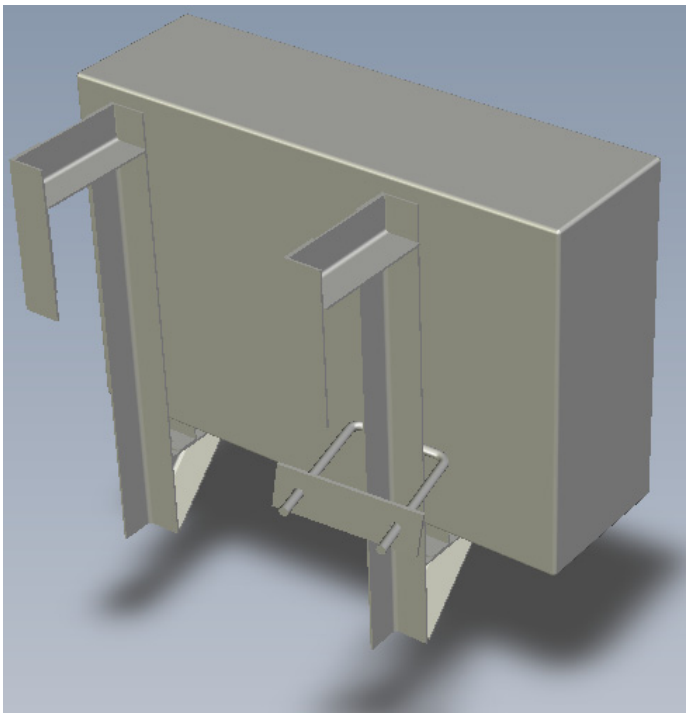


Figure 16 Tower Mounted Preview

2.3 Cable Installation

2.3.1 Installation of Power Cable and Grounding Cable

2.3.1.1 Installation Requirements

Note

The NEC(National Electrical Code) does not allow signal wires to share the same conduit with power wires unless the signal cable's voltage range is equal to the power wire's voltage range.

- Avoid bundling signal cable and grounding cable/power cable together, keep them separate.
- The power cable and grounding cable are supplied, the connectors for the booster end of power is supplied.
- Check open and short circuit before installing the power cable.

2.3.1.2 Installation

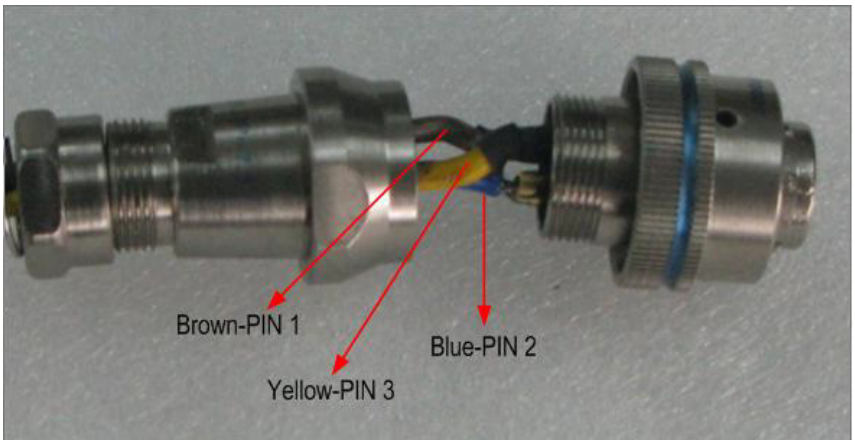
Attention

All the power switchs must be switched off before cable installation.

The installation of power cable and grounding cable is shown in Figure 17. The grounding cable should be green or yellow-green colored copper cable, with section larger than 4AWG(25mm^2) and resistance lower than 0.5Ω.

Figure 17 Installing Power Cable and Ground Cable

The connection of power cable connector is shown as following figures.



L – Brown, Pin 1

N – Blue, Pin 2

GND – Yellow, Pin 3

Figure 18 Power Cable

2.3.2 Installation and Connection of Feeders

2.3.2.1 Installation Requirements

- Shut down the base station and transmitters.
- Marking the feeder by label after installation.

2.3.2.2 Installation

The cable installation and connection is shown in Figure 19.

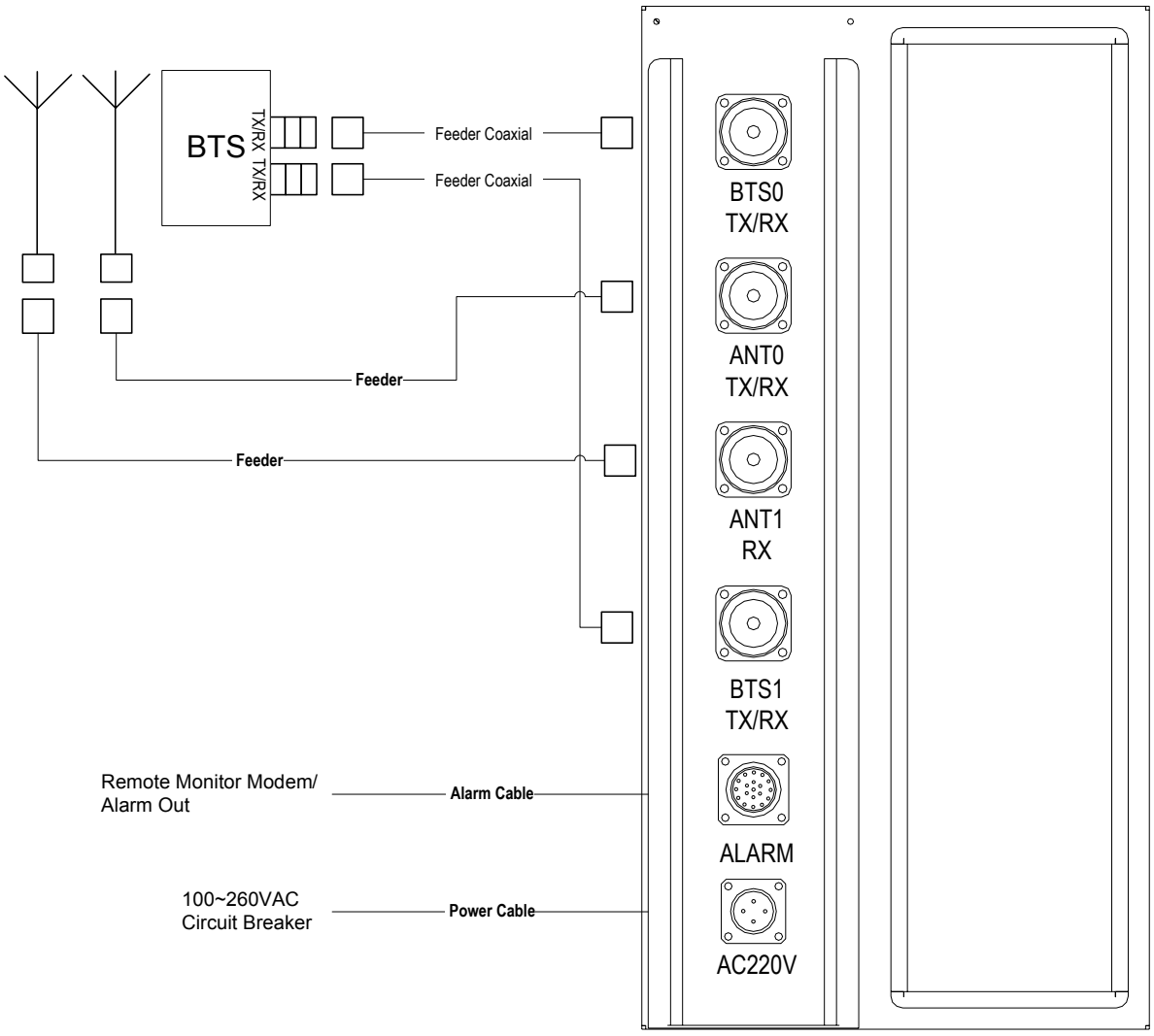


Figure 19 Cable Installation

2.4 Installation Inspection

2.4.1 Booster Inspection

Item	Description
1	Stable and normal.
2	Properly fastened to wall or floor.
3	Screws and nuts screwed tightly, without missing flat washers and spring washers. Spring washers must be on the top of flat washers.
4	No cable damage.
5	Clean, no smudges or dust.
6	Connections between metallic configurations must be reliable, to assure the reliable electric connectivity.

2.4.2 Cable Inspection

Item	Description
1	The connection of the cable is tight, not loose or damaged.
2	The cable shell not damaged.
3	Grounding cable is connected properly.
4	Cables are dressed neatly, power kept separate from signal.
5	The minimum bending radius of the cable is proper. (Shouldn't be less than twenty times of the cable's diameter.)

2.5 System Test

Test the system after the device was installed and inspected.

Test steps for Outdoor Booster:

- VSWR testing (sweep test of cables and antenna)
- Effect testing: DT/CQT testing
- Region optimize: base on the OMC-R statistic data, adjusting the base station's physical parameter, regional parameter and switch parameter. So that the system can work optimally..
- Startup setting: uplink and downlink gain setting. To see the detail in the section 4.2.2 Power Amplifier and Low Noise Amplifier Gain Setting.

See test flowing chart on Figure 14:

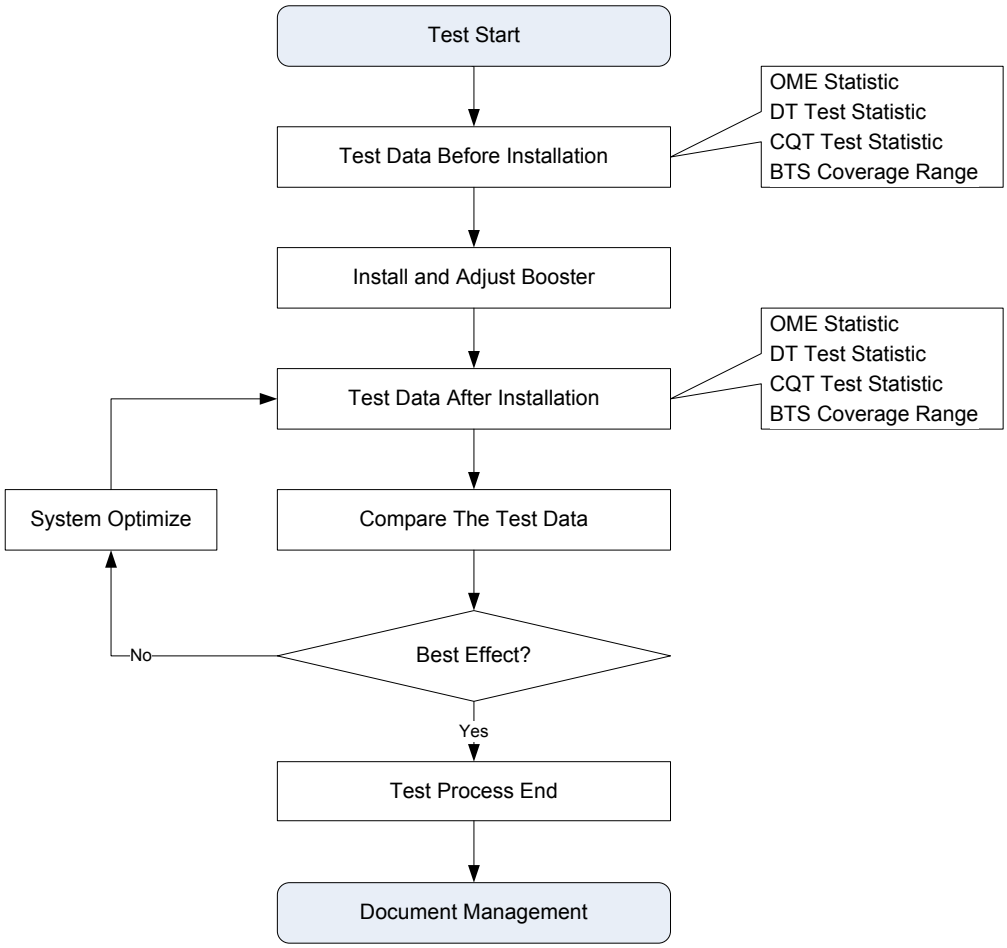


Figure 20 Flow Chart of System Debugging

3 Maintenances and Managements

This chapter describes the operation and maintenance of the outdoor booster.

3.1 System Maintenance

3.1.1 Routine Maintenance

The booster provides the following protection functions: LNA protection, overpower protection, VSWR protection and over-temp protection. When protection is triggered, the outdoor booster switches to by-pass mode and sends out alarm signal. Generally, manual maintenance is not required. A routine check every season or every half year is enough, including:

- Check the indicator status (normal or alarm).
- Check the fans working status (normal or alarm).
- Change the air filter every half year.
- Clean the dust in the convection mask both of the front and rear doors and the fans.
- If any abnormity's found, examine the system and make records.
- Check power output.

3.1.2 Indicator Lights

3.1.2.1 Monitoring and Alarm Indicator

The outdoor booster has 8 indicator lights for monitoring and alarm, as shown in the following figure:

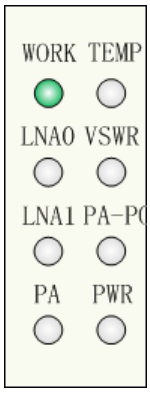


Figure 21 Monitoring And Alarm Indicator Lights

The specification of indicator lights is shown in Table 4.

Item	Label	Color	State	Description
1	PA -Power amplifier indicator light	Green	On	Power amplifier works normally
		Red	On	Power amplifier failure
2	LNA0/LNA1 -Low noise amplifier indicator light	Green	On	Low noise amplifier works normally
		Red	On	Low noise amplifier failure
3	PWR -Power indicator light	Green	On	Power supply works normally
		-	Off	No power or switch is off
4	PA-POW -Power amplifier overpower indicator light	Green	On	PA power is normal
		Red	On	PA is overpower
5	VSWR -VSWR indicator light	Green	On	VSWR is normal
		Red	On	VSWR failure
6	TEMP -Power amplifier temperature indicator light	Green	On	PA temperature is normal
		Red	On	PA is over-temperature
7	WORK -System working indicator light	Green	Flashing	System working normally
		Red	Flashing	System working failure

Table 4 Specification of indicator light

3.1.2.2 Power Amplifier Indicator

The power amplifier module has 3 indicator lights:

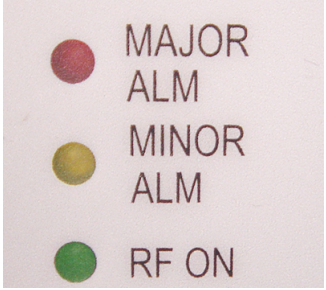


Figure 22 Power Amplifier Indicators

Item	Label	Color	State	Description
1	MAJOR ALM	Red	On	Power amplifier alarms and be shut down
	MINOR ALM	Yellow	Off	
	RF ON	Green	Off	
2	MAJOR ALM	Red	Off	Power amplifier alarms but still works
	MINOR ALM	Yellow	On	
	RF ON	Green	Off	
3	MAJOR ALM	Red	Off	Power amplifier works normal
	MINOR ALM	Yellow	Off	
	RF ON	Green	On	

Table 5 Description of Power Amplifier Indicator Lights

3.2 System Management

3.2.1 Alarm Range Setting

The factory sets alarm range settings as follows:

Item	Indicator light	Alarm	Range
1	LNA0/LNA1	Over current	Upper limit: 200mA Down limit: 42mA Referential current: 100mA
2	PA-POW	Over power	Power amplifier shut down power value: 52dBm(160 Watt)
3	VSWR	Over VSWR	Over VSWR alarm and shut down: 3.5 Over VSWR restart : 2.0
4	TEMP	Over temperature	Over temperature alarm and shut down power amplifier: ≥95°C Over temperature restart: 75°C

Table 6 Alarm Range Setting

3.2.2 Power Amplifier and Low Noise Amplifier Gain Setting and Calculation

3.2.2.1 Gain Setting

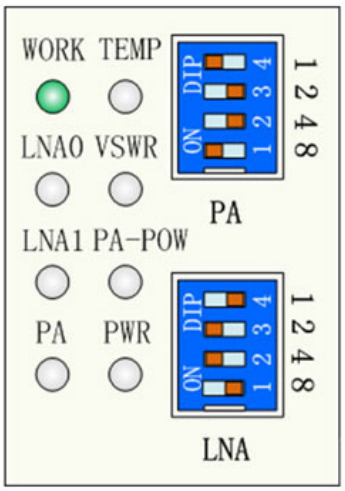


Figure 23 Power Amplifier and Low Noise Amplifier Gain Setting

Shown as Figure 23, 'PA' and 'LNA' switch are a 4 bits binary 8421 code switch, '0' for switch 'ON' and '1' for 'OFF'. See the Table 7 for the switch setting in detail.

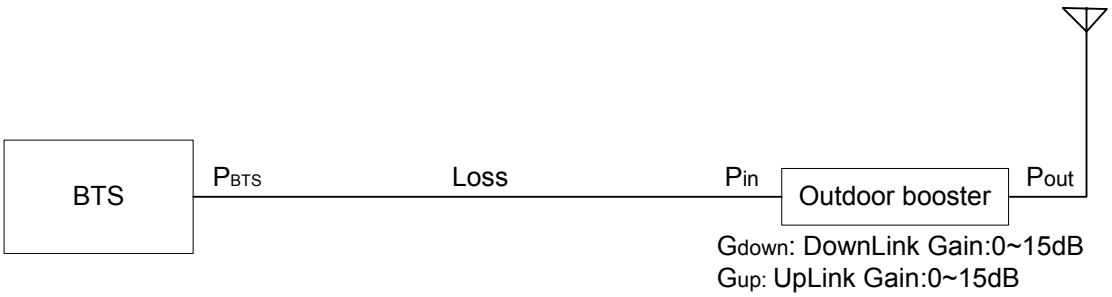
PA/LNA Gain	Switch	Switches			
		1	2	3	4
0		ON	ON	ON	ON
1		ON	ON	ON	OFF
2		ON	ON	OFF	ON
3		ON	ON	OFF	OFF
4		ON	OFF	ON	ON
5		ON	OFF	ON	OFF
6		ON	OFF	OFF	ON

7		ON	OFF	OFF	OFF
8		OFF	ON	ON	ON
9		OFF	ON	ON	OFF
10		OFF	ON	OFF	ON
11		OFF	ON	OFF	OFF
12		OFF	OFF	ON	ON
13		OFF	OFF	ON	OFF
14		OFF	OFF	OFF	ON
15		OFF	OFF	OFF	OFF

Table 7 Value Setting of the 4 Bit Binary Code Switch

3.2.2.2 Gain Calculation

Below descript the calculation of the gain of downlink PA and uplink LNA.



Item	Symbol	Description
1	P_{BTS}	BTS output power
2	P_{in}	Booster input power
3	Loss	Cable loss
4	G_{down}	PA gain
5	P_{out}	PA output power

Item	Symbol	Description
6	G_{up}	LNA gain

Table 8 Symbol Description

Method1:

The max output power of PA is 150W (51.7dBm), the gain of PA is calculated as the following formula:

$$G_{down} = P_{out} - P_{in} = P_{out} - (P_{BTS} - Loss) = 51.7dBm - (P_{BTS} - Loss)$$

On the assumption that the output power of BTS is 20W (43dBm), the cable loss is 3dB, and then the proper gain setting is:

$$G_{down} = P_{out} - (P_{BTS} - Loss) = 51.7dBm - (43dBm - 3dB) = 11.7dB$$

To avoid the over-power alarms of the booster, set the gain 1dB low, so for the above example, the PA gain is set to10dB.

Method1:

Alternative setting: set to zero, active BTS, measure power.

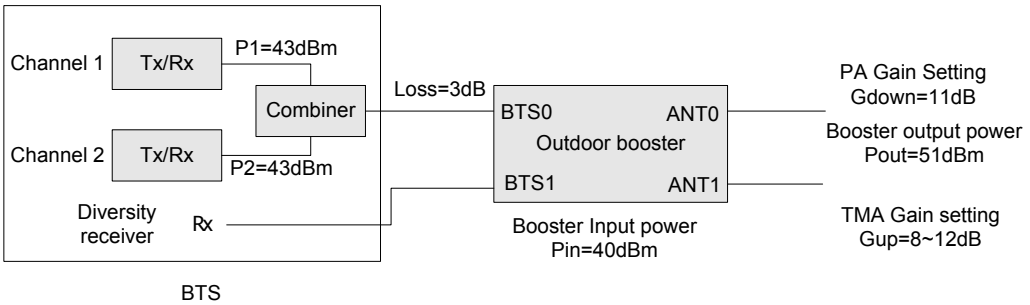
G_{up} compensates the insertion loss of feeder and booster. For engineering experience, **G_{up} = 8~12dB** is recommended.

3.2.2.3 Adjustment of PA Gain for BTS Upgrade

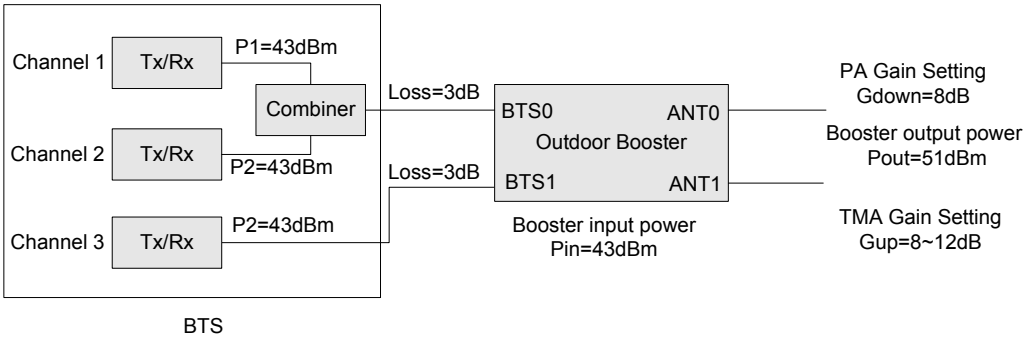
The BTS output power will be enhanced when the BTS adds channel(s) and expand capability. That means the booster's input power will be improved. Due to the booster maximum output power is unchangeable, the PA gain needs to be reset to avoid the over-power alarm. Followings are some examples of PA gain setting while the BTS adds channel(s). We suppose that the output power of each BTS channel is 43dBm, and the cable loss is 3dB.

1. **BTS is upgraded from 2 Channels to 3 or 4 Channels**

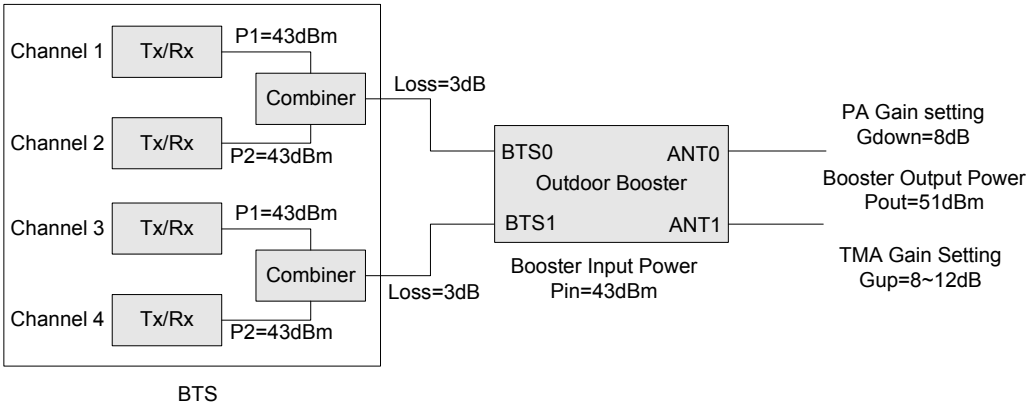
2 channels combination: PA gain setting G_{down}=11dB



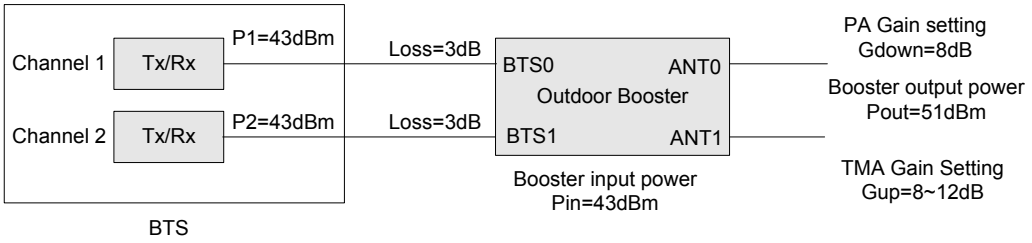
3 channels combination: PA gain setting G_{down}=8dB



4 channels combination: PA gain setting G_{down}=8dB

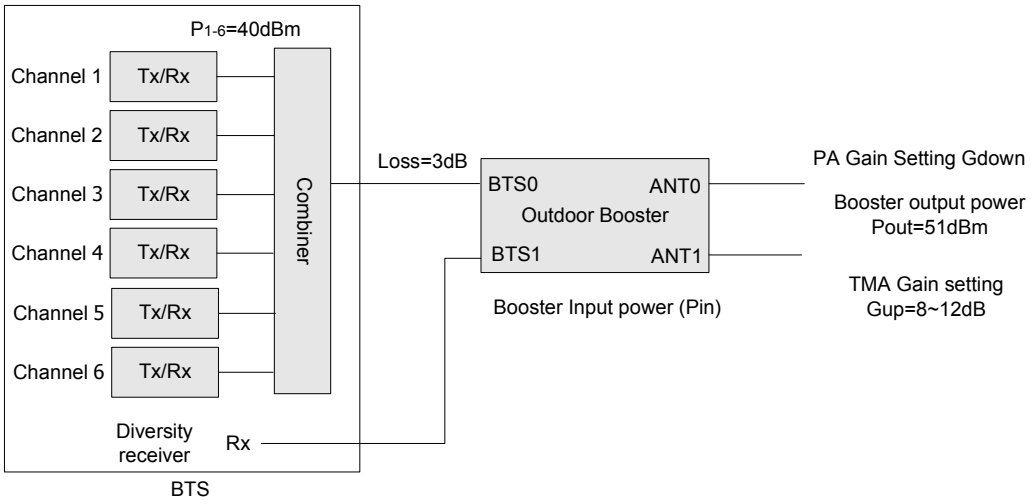


If 2 channels connect to booster as the following figure, the output power of BTS won't be changed when the BTS is upgraded to 3 or 4 channels. And there's no need to reset the PA gain of the booster.



Usually, the combination loss of 2 channels is 3dB, and there are there're differences between various types of BTS. For example:

2. 1~6 channels combination of Ericsson or Nokia BTS



For the above combination method, the PA gain setting should be 1.5dB low with one channel increasing.

The above is a reference of booster gain setting when the BTS is upgraded. The general principle is to confirm the booster input power (P_{in}). Please contact the technical support of Bravo Tech Inc., so as to make sure that the booster works normally after the BTS is upgraded.

3.2.3 Alarm and Remote Shutdown Port Specification

The alarm and remote shutdown port is shown in Figure 24, which is a 19PIN circular push-pull socket. The relevant pins will be short circuit when there is an alarm or shutdown, and the relevant pins will be open circuit when the system is normal. The specification of alarm and remote shutdown port is shown as Table 9.

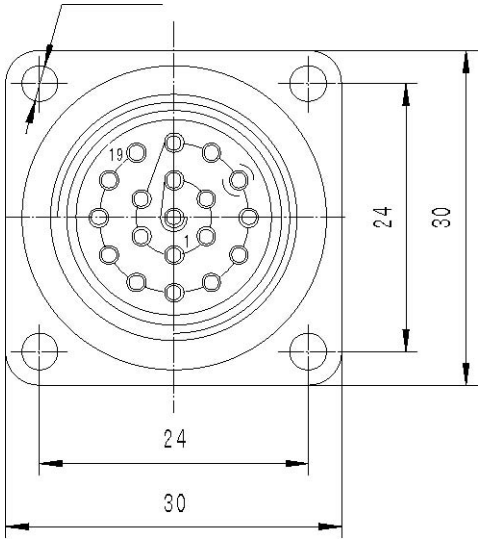


Figure 24 Alarm and Shutdown Port

Item	Alarm indicator	Specification	Relevant Pins	Notes
1	---	Shut down by remote control	Pin 1, Pin 9	Not an alarm
2	WORK	Summary alarm	Pin 2, Pin 10	
3	LNA0/ LNA1	LNA alarm	Pin 3, Pin 11	
4	PA-POW	Over power alarm	Pin 4, Pin12	
5	TEMP	Over temperature alarm	Pin 5, Pin13	
6	VSWR	Over VSWR	Pin 6, Pin14	
7	---	+12 output	Pin 7	Not an alarm
8	---	GND	Pin 15	Not an alarm

Table 9 Specification of alarm and remote shutdown port

4 Technical Specifications

RX Characteristics	Specification
Frequency Range	890-915MHz
Instantaneous Bandwidth	25MHz
Max Gain	15±1 dB
Adjustable Gain Range	0~15dB
Flatness over Frequency	≤±1dB
Noise Figure	2.5dB Typical
Output 1dB Compression (max. Gain)	+15dBm
Output IP3 (max. Gain)	+23dBm
Return loss(VSWR)	14dB (1.5:1)

TX Characteristics	Specification
Frequency Range	935--960MHz
Instantaneous Bandwidth	25MHz
Number of Carriers	4 or 8 carriers
Output Power	150W
Input Power	30~43dBm
Gain	0 - 15dB(+/-0.5dB) Adjustable in 1dB step
Gain Flatness	+/-1dB
Gain Variation Over Temp	+/-1dB
IMD	-65dBc for multi-carrier (typical)
Spectrum Masks and Spurious Emissions	FCC compliant

System Characteristics	Specification
Return loss(VSWR)	
BTS Ports	14dB (1.5:1)
Antenna Ports	14dB (1.5:1)
Monitor & Control	LNA Conditions, PA Conditions, Temp, VSWR, TX Gain Setting, RX Gain Setting
Alarm & Protection (Form C type)	Overpower Shutdown, Over Temp Shutdown, VSWR Fail Shutdown

Environmental Characteristics	Specification
Operating Temperature Range	-20˚C to +55˚C
Cold Start Temperature	-40˚C
Storage Temperature	-40˚C to +85˚C
Humidity	5%～95%
EMC	ETS 300 342-3
Ingress Protection Class	IP55

Mechanical Characteristics	Specification
Material	Steel& Aluminum Frame
Weight	50Kg

Dimensions (H x W x D)	706mm x 216mm x 437mm
RF Connectors	
BTS Ports	7/16 DIN female
ANT Ports	7/16 DIN female
ALARM Port	Circular Pull-push male, 19PIN

Reliability Characteristics	**Specification**
MTBF	
MCPA	100,000 hours
Rectifier	70,000 hours
Fan	50,000 hours
Other Parts	150,000 hours

Options	**Specification**
Power Input	100-260V AC

5 Appendix

Terms/Acronyms/Abbreviation	Definition
ANT	Antenna
AWG	American Wire Gauge
BTS	Base Transceiver Station or Base Transceiver System
°C	Degree Celsius
CDMA	Code Division Multiple Access
COM	Serial Communication Port
CQT	Call Quality Test
dB	Decibels
dBm	Power measurement referenced to the specific power level of one watt
DIN	Deutsches Insitut für Normung eV (German standards institution)
7-16 DIN	German standards RF connector: 7mm OD of inner contact, 16mm ID of outer contact.
DL	Downlink
DT	Driver Test
EMC	Electromagnetic Compatibility
LNA	Low Noise Amplifier
MCPA	Multi-carrier Power Amplifier
MHz	Megahertz
MTBF	Mean Time Between Failures
OMC-R	Operation Monitor Center - Radio
PA	Power Amplifier
RF	Radio Frequency
RX	Receive or Receiver
TX	Transmit, Transmitter
VSWR	Voltage Standing Wave Ratio